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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
10/500,017	06/23/2004	Tadao Yamamoto	04412/LH	9091

1933 7590 06/14/2007

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EXAMINER	
BOYER, RANDY	

ART UNIT	PAPER NUMBER
1764	

MAIL DATE	DELIVERY MODE
06/14/2007	PAPER

Please find below and/or attached an Office communication concerning this application or proceeding.

The time period for reply, if any, is set in the attached communication.

Office Action Summary	Application No.	Applicant(s)	
	10/500,017	YAMAMOTO ET AL.	
	Examiner	Art Unit	
	Randy Boyer	1764	

-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) OR THIRTY (30) DAYS, WHICHEVER IS LONGER, FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

1)☒ Responsive to communication(s) filed on *16 April 2007*.

2a)☒ This action is **FINAL**. 2b)☐ This action is non-final.

3)☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

4)☒ Claim(s) *1-6 and 8-28* is/are pending in the application.

4a) Of the above claim(s) _____ is/are withdrawn from consideration.

5)☐ Claim(s) _____ is/are allowed.

6)☒ Claim(s) *1-6 and 8-28* is/are rejected.

7)☐ Claim(s) _____ is/are objected to.

8)☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

9)☐ The specification is objected to by the Examiner.

10)☐ The drawing(s) filed on _____ is/are: a)☐ accepted or b)☐ objected to by the Examiner.

Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).

Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).

11)☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

12)☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).

a)☒ All b)☐ Some * c)☐ None of:

1.☐ Certified copies of the priority documents have been received.

2.☐ Certified copies of the priority documents have been received in Application No. _____.

3.☒ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

1) ☒ Notice of References Cited (PTO-892)
2) ☐ Notice of Draftsperson's Patent Drawing Review (PTO-948)
3) ☐ Information Disclosure Statement(s) (PTO/SB/08) Paper No(s)/Mail Date _____.
4) ☐ Interview Summary (PTO-413) Paper No(s)/Mail Date. _____.
5) ☐ Notice of Informal Patent Application
6) ☐ Other: _____.

DETAILED ACTION

Response to Amendment

1. Examiner acknowledges response filed 16 April 2007 containing amendments to the claims and remarks.

2. The previous rejection of claims 1-5, 7-12, 15, 16, 27, and 28 under 35 U.S.C. 102(b) and claims 6, 13, 14, and 17-26 under 35 U.S.C. 103(a) are withdrawn in view of Applicant's arguments and amendments to the claims. Examiner notes that Applicant has cancelled claim 7.

3. New grounds for rejection necessitated by Applicant's amendment to the claims are entered with respect to claims 1-6 and 8-28. The objections and rejections follow.

Claim Objections

4. Claim 23 is objected to for improper use of the English language.

5. As presently submitted, amended claim 23 reads "The chemical reactor according to claim 18, the first reaction section, the second reaction section and the third reaction section are formed on said substrate." The claim language is improper because it lacks a necessary conjunction word or phrase to link claim 23 to the claim from which it depends (i.e. claim 18). Examiner suggests correction by amending the claim to read "The chemical reactor according to claim 18, *wherein* the first reaction

section, the second reaction section and the third reaction section are formed on said substrate."

Claim Rejections - 35 USC § 102

6. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office Action:

> A person shall be entitled to a patent unless –
>
> (b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of application for patent in the United States.

7. Claims 1-6, 8-10, 15, and 16 are rejected under 35 U.S.C. 102(b) as being anticipated by Boneberg (US 6277339).

8. With respect to claim 1, Boneberg discloses a chemical reactor comprising: (a) a first reaction section (12) which has a first flow path which is provided on a surface of a substrate and in which a first reaction is caused; (b) a heating section (11) which heats the first reaction section; and (c) a second reaction section (10) which has a second flow path which is provided on the surface of the substrate and in which a second reaction is caused using heat of the heating section transmitted via the first reaction section.

9. With respect to claim 2, Boneberg discloses wherein the first reaction and the second reaction are different reactions (see Boneberg, column 3, lines 55-67; and column 4, line 1).

10. With respect to claim 3, Boneberg discloses wherein the second reaction is caused at a temperature lower than a temperature at which the first reaction is caused (see Boneberg, column 3, lines 60-63).

11. With respect to claim 4, Boneberg discloses wherein the first flow path and the second flow path are coupled (see Boneberg, drawing).

12. With respect to claim 5, Boneberg discloses wherein the second reaction section (10) comprises a vaporization reaction section which vaporizes a generation fuel, and the first reaction section (12) comprises a reforming reaction section which reforms the vaporized generation fuel (see Boneberg, column 3, lines 55-67; and column 4, lines 1-15).

13. With respect to claim 6, Boneberg discloses wherein the first reaction section comprises a reforming reaction section which reforms a generation fuel, and the second reaction section comprises a carbon monoxide elimination section which eliminates carbon monoxide produced in the first reaction section (see Boneberg, column 3, lines 55-67; and column 4, lines 1-15).

14. With respect to claim 8, Boneberg discloses wherein the heat of the heating section is transmitted from the first reaction section to the second reaction section via the substrate (see Boneberg, (see Boneberg, column 3, lines 55-67; and column 4, lines 1-15).

15. With respect to claim 9, Boneberg discloses wherein a distance between the first flow path (12) and the heating section (11) is shorter than a distance between the second flow path (10) and the heating section (11) (see Boneberg, drawing).

16. With respect to claim 10, Boneberg discloses wherein the second flow path is disposed on a periphery of the first flow path (see Boneberg, drawing).

17. With respect to claim 15, Boneberg discloses wherein the heating section (11) comprises a combustion section which performs heating by a combustion reaction (see Boneberg, column 3, lines 40-55).

18. With respect to claim 16, Boneberg discloses wherein the combustion reaction heats the first reaction section via the substrate (see Boneberg, column 3, lines 30-55).

Claim Rejections - 35 USC § 103

19. The following is a quotation of 35 U.S.C. 103(a) which forms the basis for all obviousness rejections set forth in this Office Action:

> (a) A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

20. The factual inquiries set forth in *Graham v. John Deere Co.*, 383 U.S. 1, 148 USPQ 459 (1966), that are applied for establishing a background for determining obviousness under 35 U.S.C. 103(a) are summarized as follows:

1. Determining the scope and contents of the prior art.
2. Ascertaining the differences between the prior art and the claims at issue.
3. Resolving the level of ordinary skill in the pertinent art.
4. Considering objective evidence present in the application indicating obviousness or nonobviousness.

21. This application currently names joint inventors. In considering patentability of the claims under 35 U.S.C. 103(a), the examiner presumes that the subject matter of

the various claims was commonly owned at the time any inventions covered therein were made absent any evidence to the contrary. Applicant is advised of the obligation under 37 CFR 1.56 to point out the inventor and invention dates of each claim that was not commonly owned at the time a later invention was made in order for the examiner to consider the applicability of 35 U.S.C. 103(c) and potential 35 U.S.C. 102(e), (f) or (g) prior art under 35 U.S.C. 103(a).

22. Claims 10-12, and 18-28 are rejected under 35 U.S.C. 103(a) as being unpatentable over Boneberg (US 6277339).

23. With respect to claim 10, Boneberg discloses a chemical reactor comprising: (a) a first reaction section (12) which has a first flow path which is provided on a surface of a substrate and in which a first reaction is caused; (b) a heating section (11) which heats the first reaction section; and (c) a second reaction section (10) which has a second flow path which is provided on the surface of the substrate and in which a second reaction is caused using heat of the heating section transmitted via the first reaction section.

Boneberg does not disclose wherein the second flow path is disposed on a periphery of the first flow path.

However, Boneberg explains that his chemical reactor is not specifically limited to the embodiment shown in the drawing of his disclosure (see Boneberg, column 4, lines 50-67). Moreover, Boneberg discloses the possibility for having an additional gas purification section downstream of the second reaction section (10) for further elimination of CO gas that may be present in the second reaction section (i.e. CO shift

stage) effluent (see Boneberg, column 4, lines 5-12). In this regard, Boneberg suggests that the burner unit (3) itself may similarly be designed to provide for further elimination of CO gas that may be present in the second reaction section (i.e. CO shift stage) effluent, whereby reformate product exiting the second reaction section (10) would be routed to the burner unit (3) for further elimination of CO gas (see Boneberg, column 4, lines 11-15). In such case, at least a portion of the second flow path would necessarily need to be disposed on a periphery of the first flow path so as to return the reformate product to the burner unit using the embodiment shown by Boneberg in the drawing of his disclosure.

Therefore, it would have been obvious to the person having ordinary skill in the art of chemical microreactors to provide a second flow path disposed on a periphery of the first flow path in order to return a reformate product exiting the second flow path to the first flow path in order to effect additional removal of CO gas remaining in the reformate product as taught by Boneberg.

24. With respect to claims 11 and 12, Boneberg discloses wherein his chemical reactor is compact in size (e.g. microscale). Furthermore, it is known in the art to provide grooves as flow channels for reaction components in chemical microreactors (*see generally*, S.J. Haswell et al., *Chemical and Biochemical Microreactors*, 19 TRENDS IN ANALYTICAL CHEMISTRY 389-395 (2000) (entire disclosure, and especially Fig. 1 and accompanying text)).

25. With respect to claim 18, Boneberg discloses the possibility for having a third reaction section for additional gas purification downstream of the second reaction

section (10) for further elimination of CO gas that may be present in the second reaction section (i.e. CO shift stage) effluent (see Boneberg, column 4, lines 5-12).

26. With respect to claims 19 -21, Boneberg discloses wherein the potential third reaction section would be thermally coupled to the second reaction (10) section which, in turn, is thermally coupled to the first reaction section (12) (see Boneberg, column 1, lines 30-67; and column 4, lines 1-15).

27. With respect to claim 22, Boneberg discloses wherein the third reaction section (see Boneberg, column 4, lines 5-15) comprises a vaporization reaction section which vaporizes a generation fuel, the first reaction (12) section comprises a reforming reaction section which reforms the vaporized generation fuel, and the second reaction section (10) comprises a carbon monoxide elimination section which eliminates carbon monoxide produced in the first reaction section.

28. With respect to claim 23, Boneberg discloses wherein the first reaction section (12), the second reaction section (10) and the third reaction section (see Boneberg, column 4, lines 5-15) are formed on the substrate (see Boneberg, drawing).

29. With respect to claim 24, Boneberg discloses wherein the potential third reaction section would be thermally coupled to the second reaction (10) section which, in turn, is thermally coupled to the first reaction section (12) (see Boneberg, column 1, lines 30-67; and column 4, lines 1-15).

30. With respect to claim 25, Boneberg discloses wherein a distance between the second flow path and the heating section is shorter than a distance between the third flow path and the heating section (see Boneberg, drawing; and column 4, lines 5-15).

31. With respect to claim 26, see discussion *supra* at paragraph 23.

32. With respect to claim 28, Boneberg discloses a chemical reactor comprising: (a) a first reaction section (12) which has a first flow path and in which a first reaction is caused; (b) a heating section (3) which heats the first reaction section (12); and (c) a second reaction section (10) which has a second flow path and in which a second reaction is caused using heat from the heating section, the second reaction being caused at a temperature which is lower than a temperature at which the first reaction is caused (see Boneberg, column 3, lines 30-67; and column 4, lines 1-15).

Boneberg does not disclose wherein a plurality of substrates including first and second substrates laminated on each other to form the chemical reactor.

However, it is a commonly known technique in the art of chemical micoreactors to stack thin layers (i.e. substrates) of material via microlamination techniques so as to form channels and partitions for the reaction components (*see generally*, S.J. Haswell et al., *Chemical and Biochemical Microreactors*, 19 TRENDS IN ANALYTICAL CHEMISTRY 389-395 (2000) (entire disclosure, and especially page 390)).

Therefore, it would have been obvious to the person having ordinary skill in the art of chemical microreactors to form the device of Boneberg by microlaminating a plurality of substrates one over another in order to form the flow channels of the first and second flow paths.

33. With respect to claim 28, Boneberg discloses a fuel cell system comprising: (a) a chemical reactor (1) which comprises: (i) a first reaction section (12) which has a first flow path and in which a first reaction is caused in the first flow path; (ii) a heating

section (3) which heats the first reaction section; and (iii) a second reaction section (10) which has a second flow path and in which a second reaction is caused using heat from the heating section, the second reaction being caused at a temperature which is lower than a temperature at which the first reaction is caused (see Boneberg, column 3, lines 30-67; and column 4, lines 1-15); and (b) a fuel cell which generates electricity using a fuel reformed by the chemical reactor (1) (see Boneberg, column 4, lines 5-15).

Boneberg does not disclose wherein a plurality of substrates including first and second substrates laminated on each other to form the chemical reactor.

However, it is a commonly known technique in the art of chemical micoreactors to stack thin layers (i.e. substrates) of material via microlamination techniques so as to form channels and partitions for the reaction components (*see generally*, S.J. Haswell et al., *Chemical and Biochemical Microreactors*, 19 TRENDS IN ANALYTICAL CHEMISTRY 389-395 (2000) (entire disclosure, and especially page 390)).

Therefore, it would have been obvious to the person having ordinary skill in the art of chemical microreactors to form the device of Boneberg by microlaminating a plurality of substrates one over another in order to form the flow channels of the first and second flow paths.

34. Claims 13, 14, and 17 are rejected under 35 U.S.C. 103(a) as being unpatentable over Boneberg (US 6277339) in view of Schuessler (US 6428758).

35. With respect to claim 13, Boneberg discloses a chemical reactor comprising: (a) a first reaction section (12) which has a first flow path which is provided on a surface of a substrate and in which a first reaction is caused; (b) a heating section (11) which

heats the first reaction section; and (c) a second reaction section (10) which has a second flow path which is provided on the surface of the substrate and in which a second reaction is caused using heat of the heating section transmitted via the first reaction section.

Boneberg does not disclose wherein the chemical reactor further comprises a thermometer section which measures a temperature of the heating section.

However, Schuessler discloses a reformation reactor with a reaction zone containing a reformation catalyst to which a hydrocarbon gas mixture is supplied (see Schuessler, column 1, lines 11-14). Schuessler provides temperature sensors (11, 12) in the reaction zone to monitor the reaction temperature, and explains that monitoring and adjusting the reactor temperature "ensures optimal evaporation [vaporization] under all operating states and therefore also a very good dynamic behavior during load changes" (see Schuessler, column 4, lines 57-59).

Therefore, the person having ordinary skill in the art of chemical reactors would have been motivated to modify the reactor of Boneberg to incorporate use of temperature sensors in the reaction zone (e.g. in a "thermometer section") (as taught by Schuessler) in order to ensure optimal conversion of the generation fuel.

Finally, the person having ordinary skill in the art of chemical reactors would have had a reasonable expectation of success in combining the temperature sensors of Schuessler into the chemical reactor of Boneberg because (1) both Boneberg and Schuessler are directed to the catalytic reforming of fuel, e.g. for use in fuel cell

applications, and (2) the temperature sensors of Schuessler are entirely compatible for use in the reactor of Boneberg.

36. With respect to claim 14, Schuessler discloses a chemical reactor comprising a control mechanism that causes the heating section to generate heat based on the temperature information obtained by the thermometer section (see Schuessler, column 4, lines 32-38 and 47-52).

37. With respect to claim 17, Schuessler discloses a chemical reactor having a heating section comprising temperature sensors (11, 12) (see Schuessler, drawing).

Response to Arguments

38. Applicant's arguments with respect to all claims have been considered but are moot in view of the new grounds of rejection.

Conclusion

39. Applicant's amendment necessitated the new ground(s) of rejection presented in this Office Action. Accordingly, **THIS ACTION IS MADE FINAL**. See MPEP § 706.07(a). Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire THREE MONTHS from the mailing date of this action. In the event a first reply is filed within TWO MONTHS of the mailing date of this final action and the advisory action is not mailed until after the end of the THREE-MONTH shortened statutory period, then the

shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than SIX MONTHS from the date of this final action.

40. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Randy Boyer whose telephone number is (571) 272-7113. The examiner can normally be reached Monday through Friday from 8:00 A.M. to 5:00 P.M.

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Glenn A. Caldarola, can be reached at (571) 272-1444. The fax number for the organization where this application or proceeding is assigned is 571-273-8300.

Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see http://pair-direct.uspto.gov. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free). If you would like assistance from a USPTO Customer Service Representative or access to the automated information system, call 800-786-9199 (IN USA OR CANADA) or 571-272-1000.

RPB

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